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(56) Documents Cited
WO 98/33325 A2 WO 98/33176 A2 WO 97/13248 A1
US 5659613 A

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(54) Abstract Title

Copying control for watermarked digital data

(57) Copying of watermarked DVD data or broadcast digital image data is controlled by appending a token to the data. When a copy is made the token is deleted from the data to prevent further copying. The token may also be used to control playback and reception of data. The token is generated from the DVD data using a hash code or CRC code. The technique may be applied in a set-top box, personal computer, facsimile machine or mobile telephone.

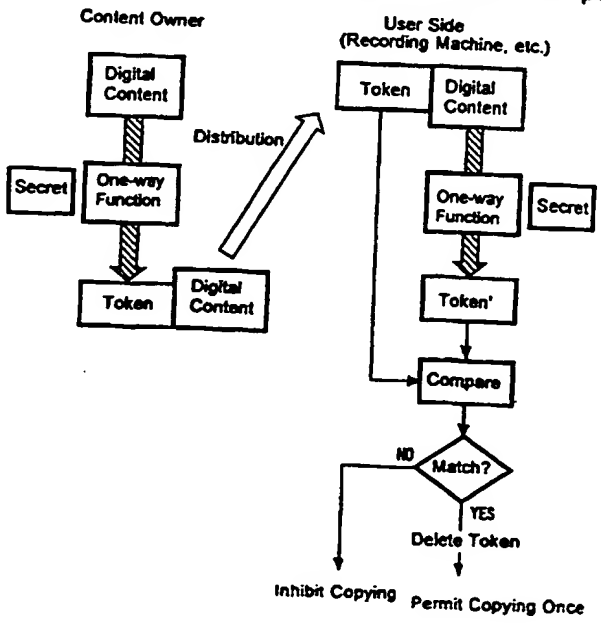

FIG. 5

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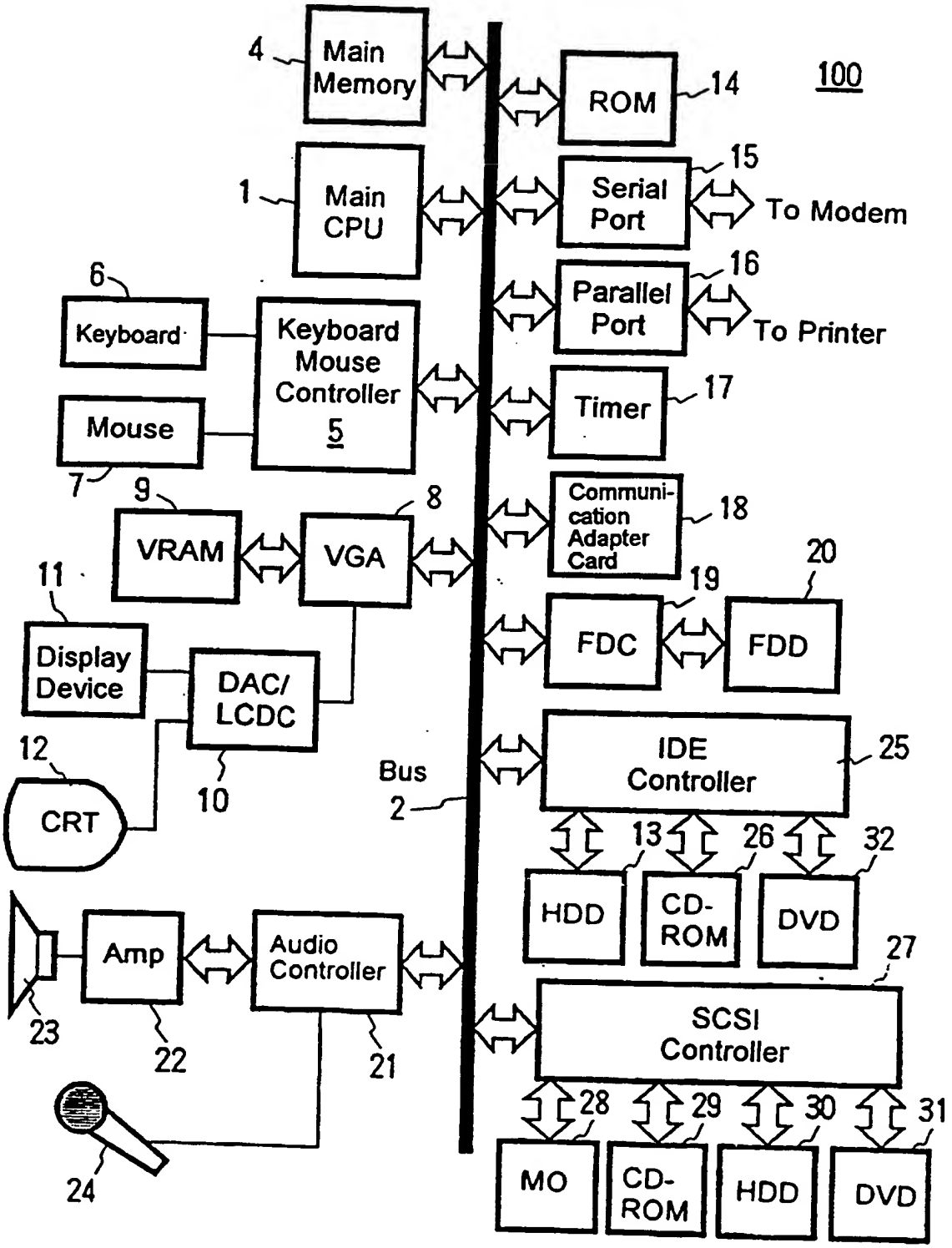

4
Main Memory
ROM
14
100
1
Main CPU
15
Serial Port
To Modem
6
Keyboard
Keyboard Mouse Controller 5
16
Parallel Port
To Printer
Mouse
7
Timer
17
9
VRAM
8
VGA
Communi-cation Adapter Card
18
11
20
19
Display Device
DAC/ LCDC
FDC
FDD
12
CRT
10
Bus 2
IDE Controller
25
13
26
32
HDD
CD-ROM
DVD
Amp
Audio Controller
27
SCSI Controller
23
22
21
28
29
30
31
24
MO
CD-ROM
HDD
DVD

FIG 1

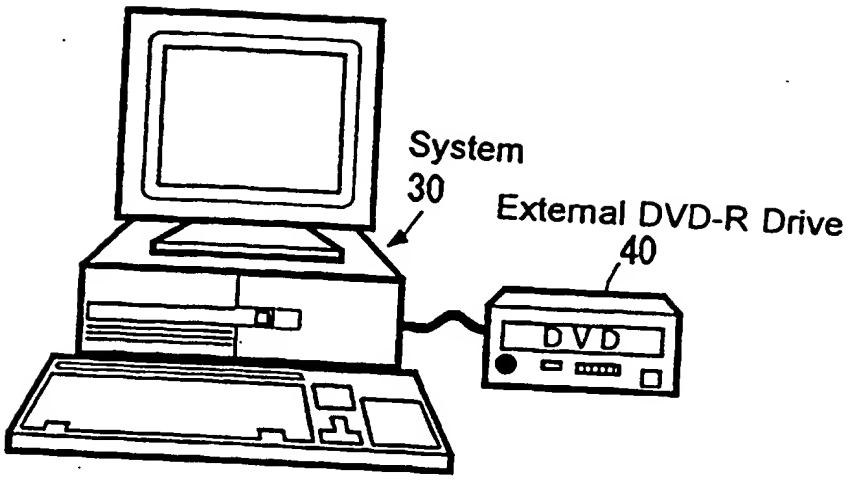

System
30
External DVD-R Drive
40
DVD

FIG. 2

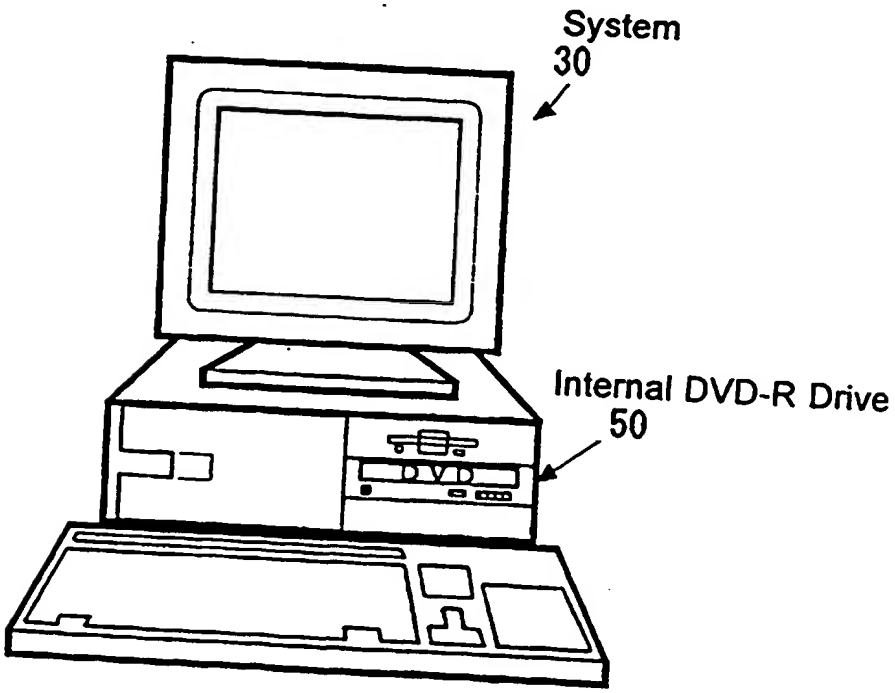

System
30
Internal DVD-R Drive
50
DVD

FIG. 3

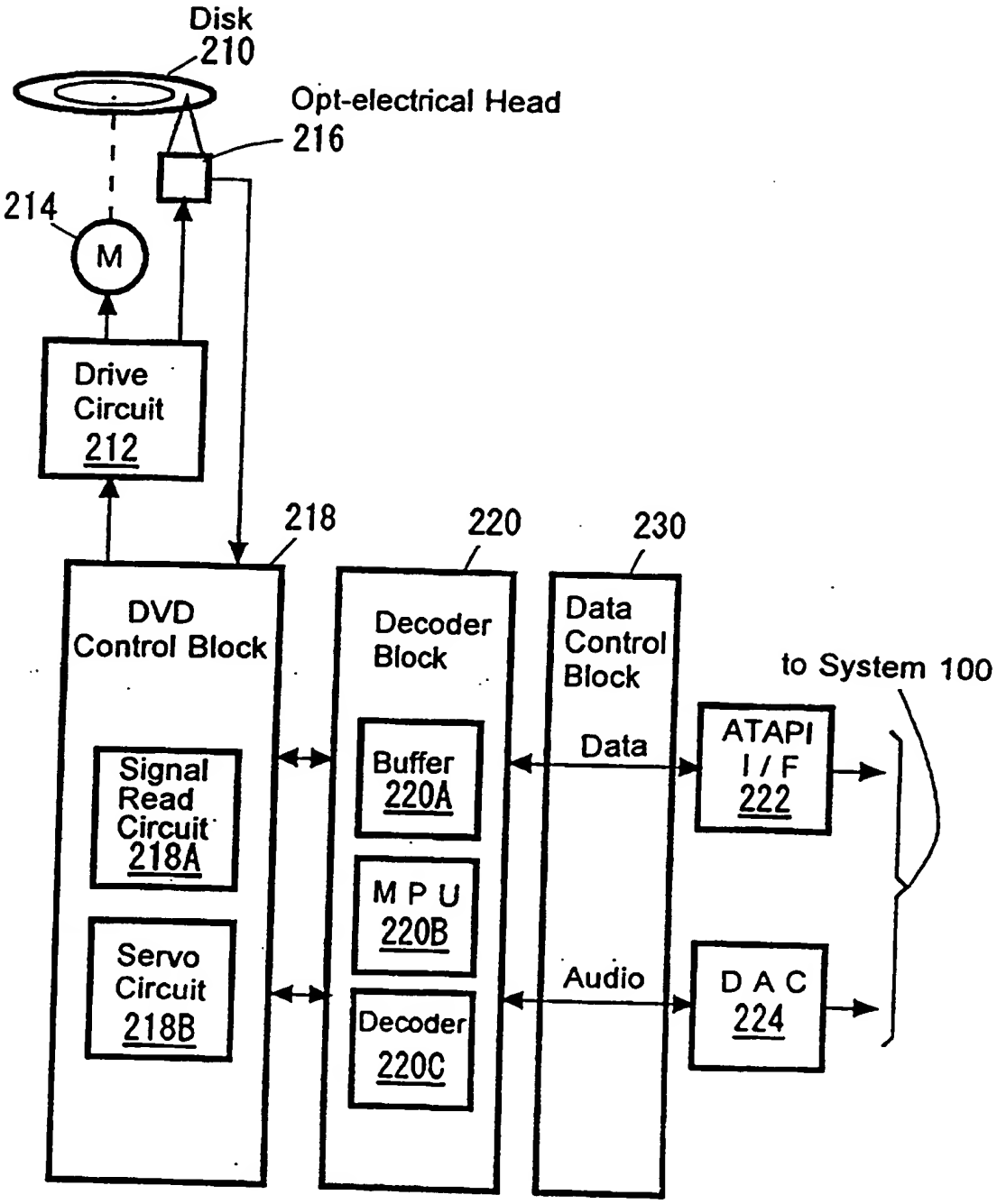

Disk
210
Opt-electrical Head
216
214
M
Drive
Circuit
212
218
220
230
DVD
Control Block
Signal
Read
Circuit
218A
Servo
Circuit
218B
Decoder
Block
Buffer
220A
M P U
220B
Decoder
220C
Data
Control
Block
Data
Audio
ATAPI
I / F
222
D A C
224
to System 100

FIG. 4

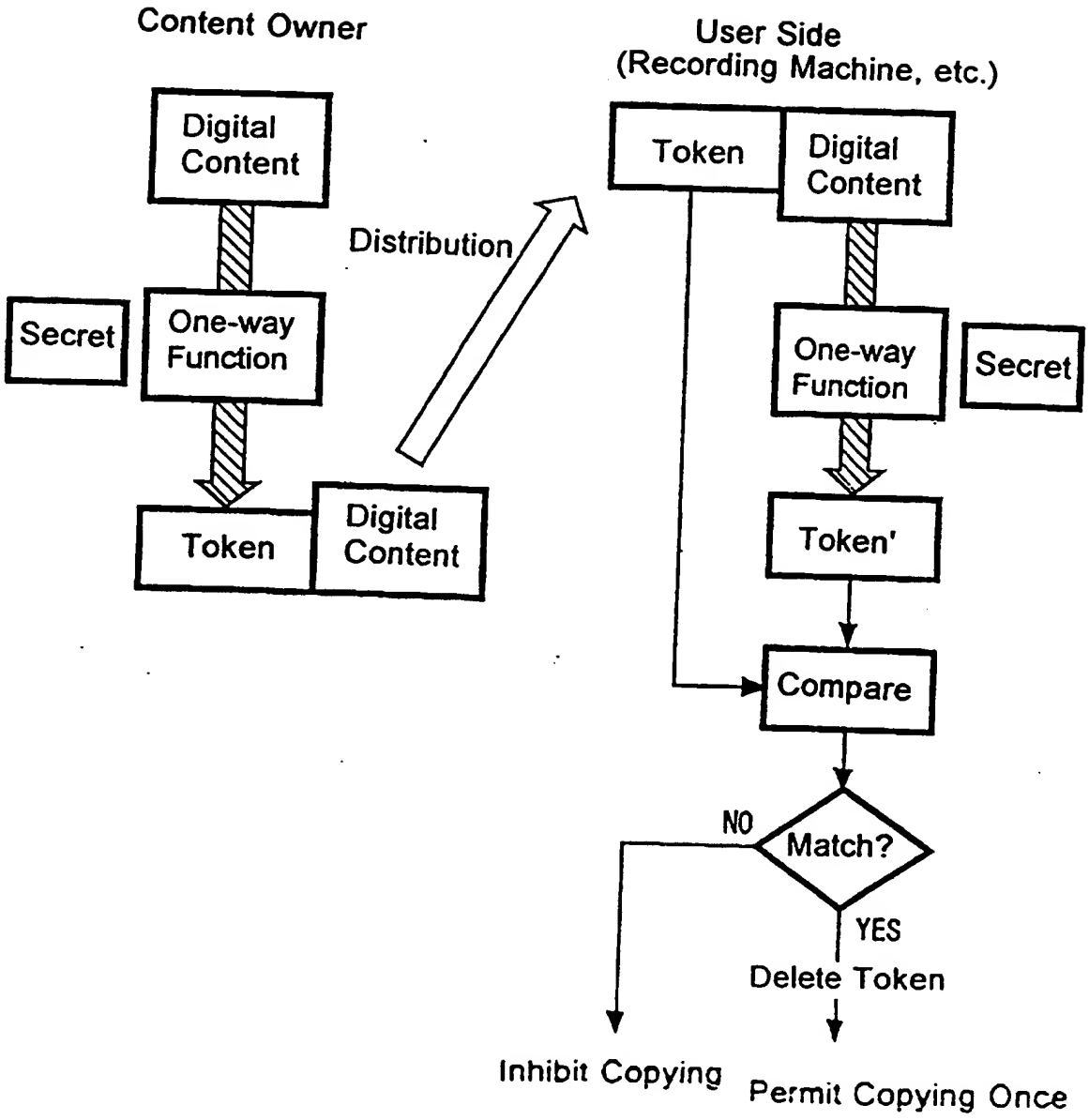

Content Owner
Digital Content
Secret
One-way Function
Token
Digital Content
Distribution
User Side
(Recording Machine, etc.)
Token
Digital Content
One-way Function
Secret
Token'
Compare
NO
Match?
YES
Delete Token
Inhibit Copying
Permit Copying Once

FIG. 5

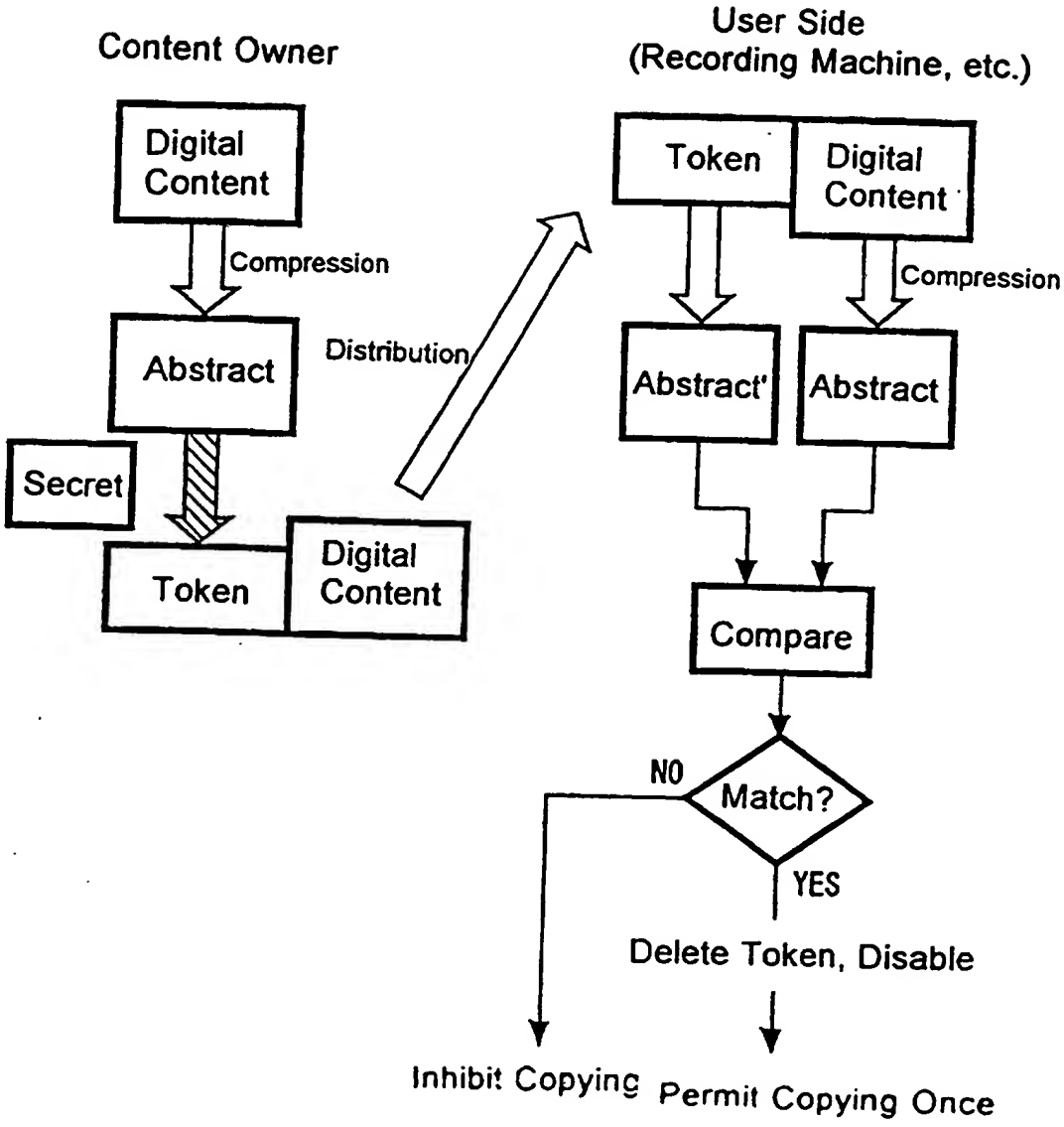

Content Owner
User Side
(Recording Machine, etc.)
Digital Content
Compression
Abstract
Distribution
Secret
Token
Digital Content
Token
Digital Content
Compression
Abstract'
Abstract
Compare
NO
Match?
YES
Delete Token, Disable
Inhibit Copying
Permit Copying Once

FIG. 6

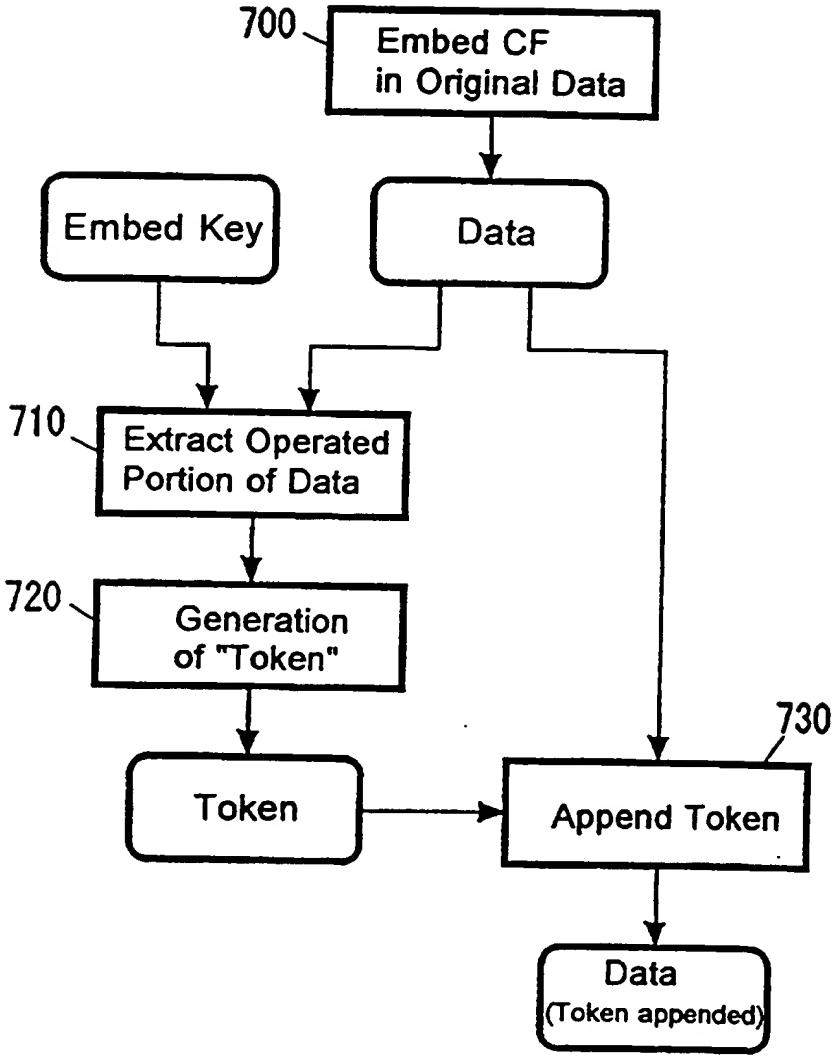

700
Embed CF in Original Data
Embed Key
Data
710
Extract Operated Portion of Data
720
Generation of "Token"
Token
730
Append Token
Data (Token appended)

FIG. 7

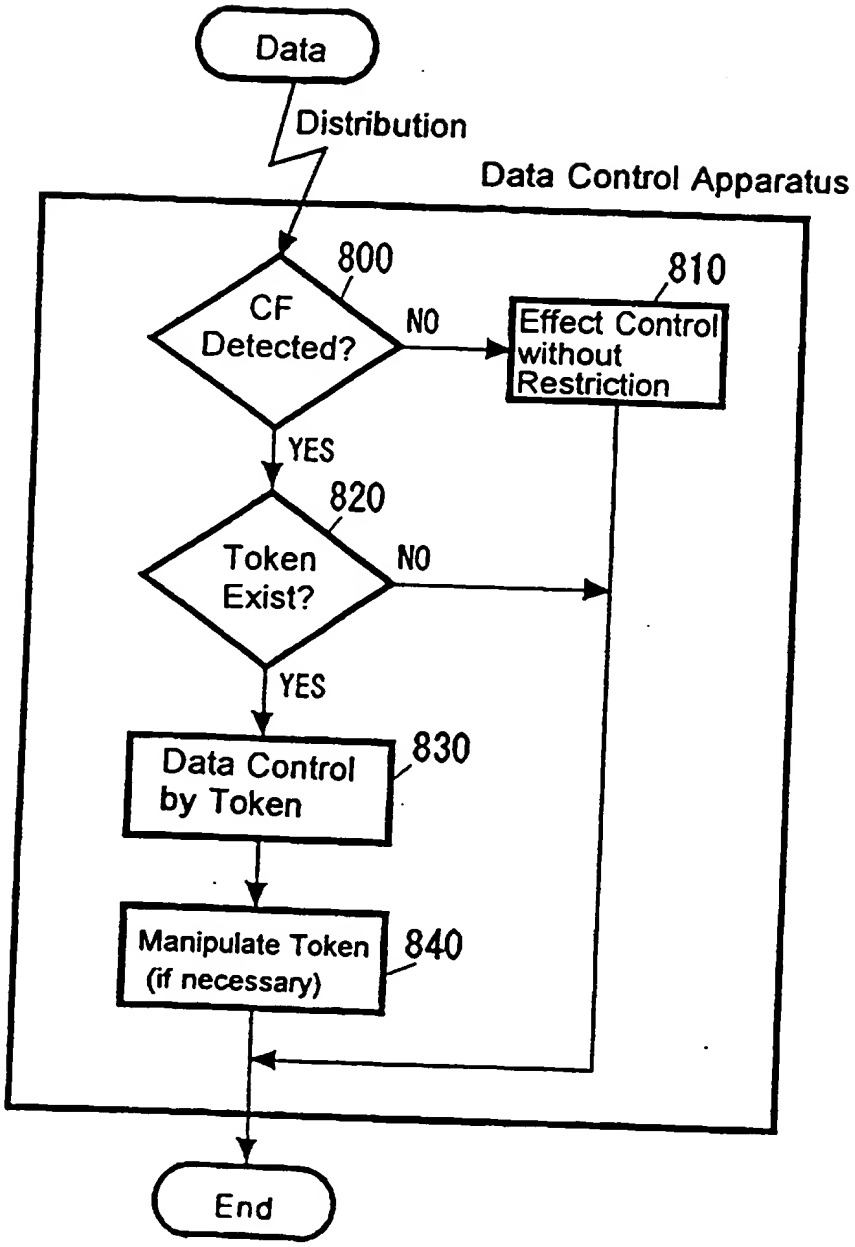

Data
Distribution
Data Control Apparatus
800
CF Detected?
NO
810
Effect Control without Restriction
YES
820
Token Exist?
NO
YES
Data Control by Token
830
Manipulate Token (if necessary)
840
End

FIG. 8

2330031

A DATA CONTROL SYSTEM AND A METHOD OF CONTROLLING PERFORMANCE OF OPERATIONS ON DATA

Field of the Invention

This invention relates to a data control system using an electronic watermarking technique (data-hiding). More particularly, this invention relates to a technique of allowing data to be handled by a desired data control (a copying control, play-back control and receiving control, for example) using a mechanism for actuating the data control and information of a manner of controlling the data.

Background

As a multimedia environment is typically widely spread out, the protection of copyrighted material is a problem. Although devices such as a digital video disk (DVD), a set top box (STB), a cable television system and a network distribution, etc., have sufficient hardware resources for distribution of movies and other multimedia presentations, no specification for content protection has been provided which sufficiently satisfies multimedia content suppliers and, in particular, satisfactorily addresses the problem of illegal reproduction (copying). No effective specification has been provided to prevent this problem despite the fact that it is very easy to copy and modify data contents of digital data. One aspect of the present invention is to provide a mechanism for safely distributing multimedia contents with a method for embedding a control mechanism in the content itself so as to allow the content to be distributed with a condition to permit copying only once (one time copy).

Some methods of data control have so far existed to protect contents and prohibit the contents from being copied and played back. PUPA 6-4026, for example, discloses a technique of generating a code 2 which is converted from a suitably generated code 1 by a one-way conversion f as a code indicating permission information of each category and the code 1 and the code 2 are both described when a permission is indicated while only the code 2 is described when prohibition is indicated to make generation of permission state difficult. However, this method allows multiple copying by saving the code 1 and thereafter describing it together with the code 2.

For example, PUPA 6-309239 discloses a method of permitting one time only copying in which, using a flag file indicating that a data file has not been copied, an encrypted data file is converted to an original data file if the flag file exists and then the flag file is erased after the data file is copied. However, because the flag file is a file separate from the data file, multiple copying is easily done simply by saving the flag file and reproducing it in this method. In addition, because it is determined that play-back is prohibited if the flag does not match or exist, even a content which is photographed or produced by an author falls in the category of prohibition.

The prior art methods basically use a code or a flag which is separate from the data in applying a data control. Once such separate code or flag is identified in such methods, manipulation of such code or flag is possible so that these methods have a weak point against a wilful attack by a third party. A technique usable for data control which is free from such disadvantages is desired. Further, it is desired to obtain a novel data control method which is totally independent of conventional data control methods and is upward or downward compatible without requiring significant changes to video distribution systems or the mechanism of devices.

Electronic watermarking techniques exist for the copyright protection of a still image, motion picture and voice. The electronic watermarking technique is a technique which is also called data hiding (TM). Simply stated, this is a collective name for techniques for embedding certain information in other media (still image, voice and motion picture, etc.) and aims at integrating the information in a medium in which the information is embedded rather than the way of hiding information as used in encryption. In other words, a method is employed for embedding information which is desired to be hidden in the data of a medium by manipulating the data of the medium. This means, in image data for example, information other than the essential data is carried by modifying a pixel value such as the brightness. Incidentally, the term "embed" as used in this invention means that extra information is hidden in the form of modification of the data itself.

One of the major characteristics of electronic watermarking is that it is an invisible or inaudible marking technique. When embedding information in media, the existing data is so modified (data modification) that the modification is not detectable by human eyesight,

rather than appending data bits. The total data size is not increased by embedding the additional information. For example, embedding data in an image consisting of 640 x 480 pixels does not increase the number of pixels. Also, by embedding text information or voice information in an image, it is enough for the storage side to handle a single kind of medium. One of the most useful characteristics of watermarking is the inseparability of embedded information. Because the electronic watermarking embeds the appended information directly in the data structure of the medium rather than a header or a file, the embedded information can subsequently be detected even if the platform or the data format changes so long as the quality of the original data is preserved.

An example of a possible data control method using electronic watermarking techniques is given below. Operations such as recording, copying and play-back of data contents by apparatus to which the data has been delivered, and also operations such as broadcasting of data by a radio wave, whether to permit receiving of data or not (receiving control), can be controlled in a similar manner. The method includes:

(1) a step of embedding a control flag (CF) indicating a protection level of the contents in video data using a electronic watermarking technique,

(2) a step of detecting the CF embedded in said contents to determine whether or not recording or play-back of the video is permitted for suitably controlling recording or play-back (video recording is stopped when a CF indicating prohibition of recording is detected during recording and play-back is stopped when a medium played back is for recording and a CF indicating prohibition of recording is detected during play-back.), and

(3) a step of permitting recording and leaving a record indicating that the video has been recorded when a CF indicating permission of one time only recording is detected, and prohibiting another recording by the CF and the recorded mark when the recorded contents are played back and another recording is attempted.

The steps (1) and (2) can be implemented by embedding a CF in the contents in advance by the electronic watermarking technique in preparing the contents. The step (3) can be also implemented to prohibit another recording using the electronic watermarking in the manner similar to the

steps (1) and (2). However, a problem exists in this case. Video recording apparatus is typically owned by an end user, and it has to be made compactly and at a low price. It is practically difficult to use electronic embedding of watermarks for appending a mark indicating the performance of a recording operation, since we must take image quality and residual signal intensity into consideration and such end-user apparatus has a limited processing capability.

Additionally, when the subject video data is image data which is MPEG compressed, for example, it is necessary to restore the image data which has embedded therein a mark that recording has been performed by re-composing it with the rest of the data (voice data and sub-picture, etc.) in addition to separation of video data for detecting the CF. The sum of buffers and circuits required therefor would amount to more than twice as large as the CF detection circuit and this does not give a practical solution. Further, because video data which is subjected to embedding of information consists of I-frame, a disadvantage exists in which the embedded information does not remain in other frames (B and P) when the data is decompressed.

Summary of the Invention

According to the invention, there is provided a system and a method for secure control of data operations using a electronic watermarking technique, as set out in the claims.

A first embodiment of the invention according to this aspect provides a system for securely controlling copying, play-back and receiving of data using an electronic watermarking technique. Use of "invisible" electronic watermarking is more resistive to an attack by a wilful third party than alternative techniques which rely solely on additional control bits associated with a file. A method and system of data control according to the invention can also be less expensive than methods and systems which rely solely on watermarking for data control, while still having at least equal functionality. The invention can provide a novel method and system of data control which are independent of the prior art methods of data control but are still capable of co-existing with existing methods.

According to one embodiment of the invention, a data control system (having the capability for control of copying, play-back and receiving)

is built which implements the method steps of: embedding a control flag for control of data, using an electronic watermarking technique; preparing a token having information as to how to control the data (number of copies and play-backs, designation of reproducing equipment and user, etc., for example) by using the content of said data; distributing said token appended to said data; detecting said control flag from the distributed data; reading said token appended to said data when said control flag is detected; and controlling said data according to a predefined control rule (a rule deciding the type of control by a combination including the token, flags and type of media) of said token or said control flag.

In a preferred embodiment of the invention, a subsequent data processing operation can be suppressed by modifying the token (deletion of the token, change of the number of the tokens, modification of token preparing image part) which is used in controlling the data.

Brief Description of the Drawings

An embodiment of the present invention will now be described in more detail, by way of example, with reference to the accompanying drawings in which:

Fig.1 shows an embodiment of a hardware configuration of a data control system.

Fig.2 is a schematic diagram of a data control system which uses an externally attached DVD drive.

Fig.3 is a schematic diagram of a data control system which has a DVD drive installed internally.

Fig.4 is a block diagram of a DVD-R data control system.

Fig.5 shows a copying control system in digital image distribution which utilizes a one-way hash function.

Fig.6 shows a copying control system in digital image distribution which utilizes an asymmetrical key.

Fig.7 is a diagram showing the flow of a token generating process.

Fig.8 is a diagram showing the flow of a data control process.

Detailed Description of Preferred Embodiment

A preferred embodiment of this invention will now be described with reference to the drawings.

Preparation of a token and the data control will firstly be explained. The process flow of preparation of a token is shown in Fig.7. In step 700, a CF is embedded in the original data using an electronic watermarking technique. The data as used here includes an image, a voice, a still image and a motion picture. Next, in step 710, a portion from which the token is to be prepared is extracted from the data in which the CF is embedded using an embedded key. A token is prepared from the extracted data using a one-way function in step 720. The token may be prepared from an abstract by a method using an asymmetrical key instead of the one-way key. Otherwise, a plurality of tokens may be prepared using different keys. In step 730, the prepared token is appended to the data in which the CF is embedded using a user data area.

The process flow of data control is shown in Fig.8. In step 800, it is determined whether or not there is a CF embedded using the electronic watermarking technique in the distributed data. If a CF is not detected in the step 800, a control which is in no way restricted, such as copying, recording and play-back, etc., is done. If a CF is detected in the step 800, it is determined in the step 820 whether or not there is a token which is appended (a validation of the token may be included at this time). If the result of the step 820 is NO, data control is inhibited. That is, copying, recording or play-back is not done and the process ends. If the result of the step 820 is YES, a data control (copying, recording or play-back, etc.) is done according to a predefined control rule of the token or the above control flag. The predefined control rule as used here is a rule which defines the content of the control according to the token and the flag as well as the kind of data recording/reproducing media, etc. The content of the control is typically decided by a combination of parameters arrayed in a table. Methods of such combination are not described in detail because they are known. Those skilled in the art can easily modify the rule to a more detailed form so as to implement a variety of controls. If necessary, the token is

manipulated in the step 840 to modify the subsequent data control. Manipulation of the token means a change of the number of the tokens to limit the number of copyings, and deletion, disabling and modification of the token. In addition, the portion of the data from which the token is to be prepared may be manipulated. The token may be manipulated before the data control is done by the token for the purpose of security.

The roles of the control flag and the token are same except that a predetermined data control is done only when the control flag exists. Information to control the data (the number of permitted copies, etc.) may be included in either the control flag or the token, or in both.

Fig.1 shows an embodiment of a hardware configuration of a data control system used in this invention, including for controlling copying, play-back and receiving, and preparation of a token. The system 100 comprises a central processing unit (CPU) 1 and a memory 4. The CPU 1 and the memory 4 are connected to a hard disk device 13 (or a recording medium drive device such as an MO, a CD-ROM 23 and a DVD 32) as an auxiliary storage via an IDE controller 25. Similarly, the CPU 1 and the memory 4 are connected to a hard disk device 30 (or a recording medium drive device such as an MO 28, a CD-ROM 23 and a DVD 31) as an auxiliary storage via an SCSI controller 25. A floppy disk device 20 is connected to the bus 2 through a floppy disk controller 19.

A floppy disk is inserted to the floppy disk device 20. A computer program code which gives instructions to the CPU and the like in cooperation with an operating system to practice this invention is recorded in the floppy disk, the hard disk device 13 (or a recording medium such as an MO, a CD-ROM and a DVD), 30 and a ROM 14 and executed by being loaded in the memory 4. The computer program code may be compressed or divided into pieces for recording in a plurality of media.

Further, the 100 may be provided with a user interface hardware including a pointing device 7 (a mouse and a joystick, etc.) for inputting, a keyboard 6 and a display 12 for presenting visual data to the user. Further, a printer may be connected via a parallel port 16 and a modem may be connected via a serial port 15. The system 100 can be connected to a network via the serial port and the modem or a communication adapter 18 (Ethernet an token ring cards) for communication with other computers and the like. In this invention, the distributed data can be sent and received by the serial port 16 and the modem or the

communication adapter 18 in addition to distribution by a medium such as a floppy disk. Further, a remote transmitter/receiver may be connected to the serial port 15 or the parallel port 16 for transmitting/receiving by means of infrared or radio wave radiation.

A speaker 23 receives an audio signal from an audio controller 21 via an amplifier 22 for output as a voice. The audio controller 21 A/D (analog/digital) converts voice information received from a microphone 24 to allow voice information external to the system to be detected in the system.

As such, it will be readily understood that the data control system of this invention may be practiced by a conventional personal computer (PC), a workstation, a notebook PC, a palm top PC, a network computer, home electric appliances such as a television set and a facsimile equipment implementing a computer, and communication terminals including a game machine having a communication function, a telephone set, a facsimile equipment, a portable telephone, a PHS, an electronic notebook, or a combination thereof. It should be noted, however, that these components are given for exemplary purpose and it is not meant that all of these components are the indispensable components of this invention.

An embodiment of a DVD-R system for preparing a token and controlling data is now described. Fig. 2 shows a case where the DVD 31 or the DVD 32 of the system 100 is externally connected while Fig.3 shows a case where they are internally implemented. An externally attachable DVD-R drive 40 and an internally implemented DVD-R drive 50 are connected to the system 100 by an IDE (ATAPI: ATA Packet Interface) interface (they may be connected via SCSI). A block diagram of the DVD-R system is shown in Fig.4.

In Fig.4, a disk 210 is driven by a motor 214 which is connected to a drive circuit 212 and data recorded in the disk 210 is read by an opt-electrical head 216. The drive circuit 212 operates by a command from a DVD control block 218. The signal read by the opt-electrical head 216 is inputted to the DVD control block 218 where it is amplified, converted if necessary, and sent to a decoder block 220. The decoder block 220 modulates and demodulates the signal and corrects an error of the signal. The DVD control block 218 includes a servo circuit 218B receiving a control signal from the decoder block or servo data recorded in the disk

to control the drive circuit 212. The DVD control block 218 also includes a signal reading circuit 218A.

The data received in the decoder block 220 is error corrected by a buffer 220A, an MPU 220B and a decoder 220C in the decoder block which are connected by a common bus, decoded in real time and sent to a data control block 230. In the data control block 230, generation of a token, appending the token to the object data, detection of CF information, data control by the token and manipulation of the token are done using an electronic watermarking technique. Image data is sent to the system 100 via an ATAPI interface 222 while voice data is sent to the system 100 via a DAC (digital to analog converter) 224.

In recording, the data flows conversely to reading from the ATAPI interface 222 through the data control block 230, and the decoder block 220 to the DVD control block. The opt-electrical head 216 operates as a recording head at this time. While the above DVD-R data control system cooperates with the data processing system 100, a stand alone DVD play-back machine or a stand alone DVD-R recording machine can also work without departing from the substance of this invention.

Fig.5 shows an embodiment of a copy control system in digital image distribution using a one-way hash function. In summary, this is a system which prohibits a further copying or recording by appending a token to a broadcasted digital data for controlling copying or recording using an electronic watermarking technique and disabling the token once the data is copied or recorded. While the token may include information as to the manner of controlling data (the number of permitted copies, the number of permitted play-backs, designation of reproducing equipment and designation of a user, etc.) as the CF (control flag) does, it is assumed in Fig.5 and Fig.6 that whether data may be copied or not is determined depending on the presence or absence of a token for simplifying the description. Further, the number of tokens may be changed to a desired number depending on the environment of implementation (the number of the tokens may be defined as the limit of the number of copies or play-backs for example).

In the embodiment of Fig.5, a CF indicating to allow copying up to one time is embedded in the content by an electronic watermarking technique. The recording machine is allowed to copy only one time only when this CF is detected. The result of arithmetic operation of a digital

content is appended to the digital contents such as a digital image, a digital video and a digital audio (including a compressed stream such as MPEG). The result of the arithmetic operation is called a "token". It is determined whether copying or play-back is permitted or not depending on the presence or absence of the "token".

The copying control system is now described in more detail. In Fig.5, the token is a bit string which is calculated from a part (or all) of image data using a one-way hash function, etc., and is recorded or held in a predetermined place as a comment field or user data and distributed along with the image data. The one-way hash function for generating a token is publicly known and includes MD5 or CRC (Cyclic Redundancy Check). The function to generate a token or the portion of the image to which arithmetic operation is applied is held in secret to prevent the token from being generated in the user side.

The image data to which a one-way hash function is applied is selected by an embedded key. The portion of the image data to be used and the initial value of the hash arithmetic operation are kept in secret while the hash function itself to be used is open to public. The generated token is appended by recording it in an append data area (the user data area in MPEG2, for example, 8 x n bits can be used with 8 bits per unit). On the other hand, the one-way hash function is generally expressed by;

$$h = H(M)$$

where M is a message (numerical value) of an arbitrary length, h is a numerical value of a fixed length and H is a defined hash function. The one-way hash function is defined as satisfying the following conditions in addition to the above condition.

- it is easy to calculate h when M is given.
- it is difficult to calculate M (reverse conversion) when h is given.
- it is difficult to find M' which satisfies $H(M) = H(M')$ when M is given.

This characteristic is utilized to electronically sign the data, authenticate or detect whether or not modification is involved. The input message M may be a plurality of elements. An example of generating a hash by the following method is given here.

$H_i = H(I^i, H^{i-1})$ $\quad (I^0 = k)$

Namely, M^i is a combination of I^1, I^2,....I^n and the first to the i-th hash values. I^i is an image data block and n blocks I^1 to I^n are selected by an embedded key. H_i is the hash value of the i-th image data block and a hash value is obtained by taking I^i and up to (i-1)th hash values (h^{i-1}) as an input and repeating the arithmetic operations by a number of times equal to the number of the image data blocks (n) which is the subject of the arithmetic operations. I^0 is represented by a constant and is also held in secret along with the embedded key.

In generating a token, an effective token is appended only when a CF which is embedded by an electronic watermarking technique indicates that the content may be copied once. The token is also generated from a signal detected from a mark embedded by an electronic watermarking technique. In this case, a token or an abstract is generated using a signal from an electronic watermarking detector in authenticating the token in the user side.

The generated token is written in the user data (UD) area of extended data which exists in a sequence header of the MPEG format, for example. The generated token may be recorded by scrambling it with an asymmetrical key. In this case, the token can not be generated even if a clacker can know the portion of image information which is used for generating the token.

In the user side, the token is authenticated as being valid only when the CF embedded by an electronic watermarking indicates that the content may be copied once. A token is generated in a similar manner in a recording machine, etc., from a distributed image and is verified to see whether or not it matches the token which is distributed along with the image. If it can not be authenticated, recording is inhibited. Also, copying to analog form is prevented by appending an analog protection signal or CGMS-A data to the analog output of a DVD reproducing machine. If it is authenticated, a stream in which the token is deleted or disabled is recorded. Disabling (which is enough to create a mismatch with the result of arithmetic operation) is done for the token. Or, it is done by modifying the portion which is used for generating the token (if the token is generated from a modified image, it does not pass the verification because it is not a true token). When a further copying is

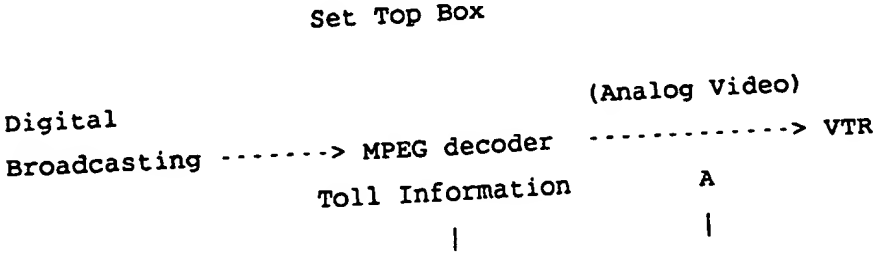
attempted, recording is inhibited because an effective token does not exist.

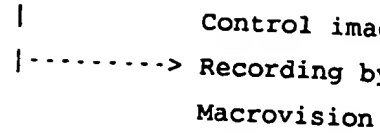
A content having a token associated therewith must not be a copy. If this is detected in a stream from a writable DVD, it is deemed to be illegally copied and play-back is inhibited.

A system of generating a token using an asymmetrical key from an abstract made of a compressed image is shown in Fig.6 as another embodiment of a copying control system in digital image distribution. The basic mechanism is same as the case where the one-way hash function is used. An important point in the case where a token is generated using an asymmetrical key lies in that the method of generating a token from an abstract is kept in secret while generation of an abstract from a token is open to public. In the user side, an abstract is prepared from a distributed token using a publicly open key and compared with an abstract similarly prepared from a distributed image to verify the match. Copying is inhibited when a token is valid despite the CF does not permit one time copying. Further, the token is disabled.

Without being limited to a data control, a system permitting to exercise a right only once may be similarly implemented by granting a certain right by appending a token and disabling the token when the right is exercised. For example, one can implement a method in which a token is attached to an electronic money and is disabled when the money is paid.

A method of controlling copying with a simple structure within an STB is next described as an application of this invention. As a method of receiving a toll digital broadcasting like a satellite broadcasting and controlling analog image recording based on toll information, Macrovision has existed. However, there has been no method of a handy control within an STB for recording a digital signal output in a digital recorder such as a DVD-RAM as it is. A conventional method of controlling an analog image recording using Macrovision is now described hereunder.

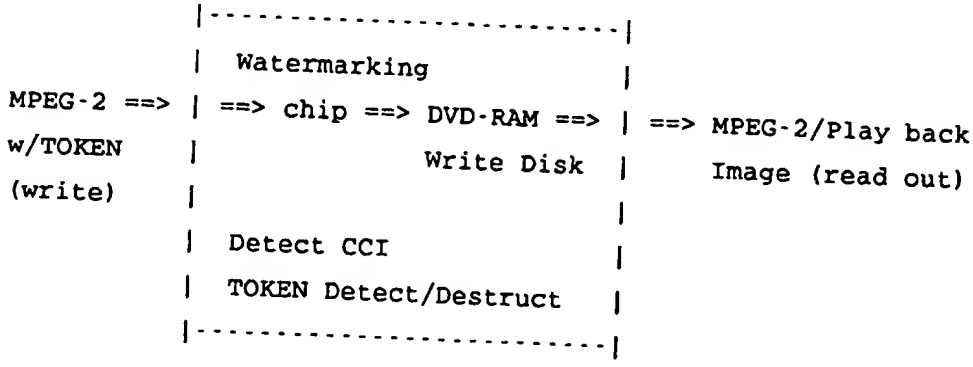




In order to allow a copy permission of a digital output to be simply granted within an STB only when a subscriber pays a toll, etc., in a toll digital broadcasting such as a satellite broadcasting, a control flag and a token are looked at. The reason of this is as follows.

With the control flag embedded by watermarking being Copy Control Information (CCI) of 2 bits, permission or prohibition of image recording/play back in a digital recorder such as a DVD-RAM is controlled by detecting a token (TOKEN) included in the User Data Area of MPEG-2 as described hereunder.

Digital Recorder like a DVD-RAM



Copying control for writing and reading by a combination of the CCI and the token is as follows.

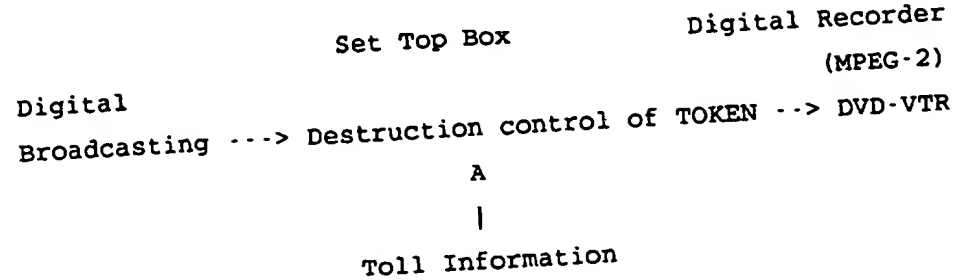
For writing

CCI/TOKEN	COPY Permission
(1,1)	NO COPY
(0,0)	COPY OK
(1,0) + TOKEN	COPY OK (Destruct TOKEN in writing)
(1,0)	NO COPY
(-,-)	COPY OK

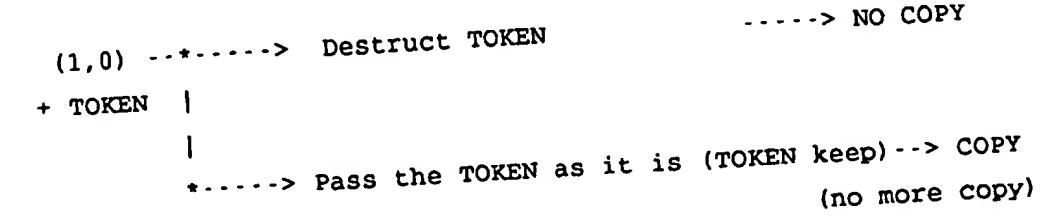
For reading out (from DVD-RAM)

CCI/TOKEN	COPY Permission
(1,1)	NO PLAY
(0,0)	PLAY
(1,0) + TOKEN	NO PLAY
(1,0)	PLAY
(-,-)	PLAY

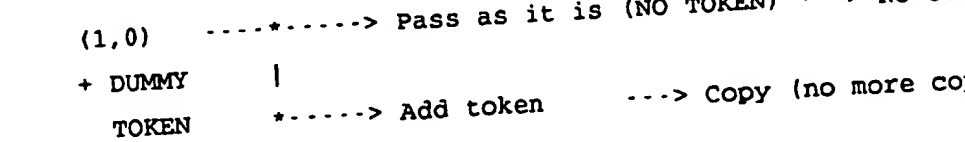
It will be seen from the above that copying permission can be done within an STB by looking at the CCI(1,0) + TOKEN.



By having the sending side send out a MPEG-2 stream with CCI(1,0) and a token associated beforehand thereto and having the receiving STB control destruction of the token or passage of the token as it is based on the toll information which is input information from the exterior, for example, in a digital broadcasting, recording in an equipment having a watermark detecting chip, such as a digital recorder like a DVD-RAM is controlled as follows.

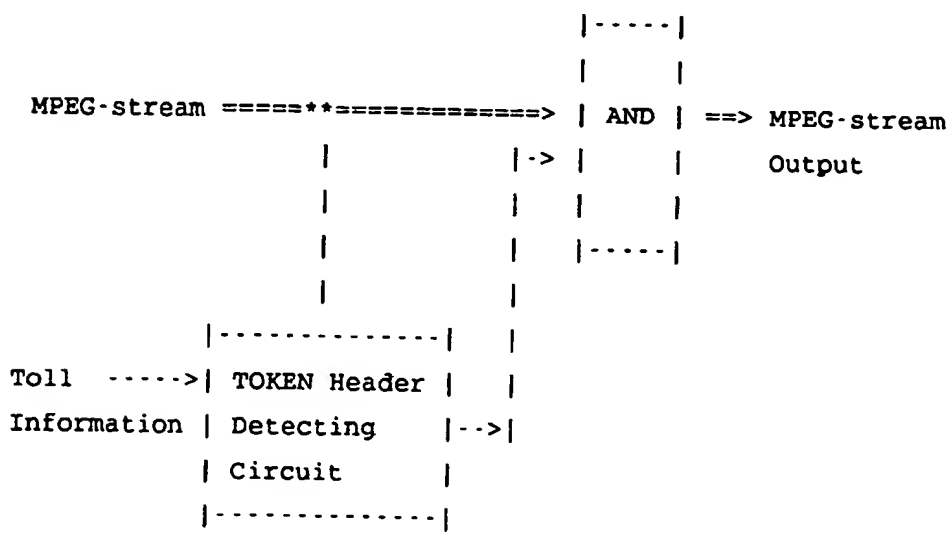


In addition, a method of embedding an invalid token in a portion corresponding to the token instead of putting a token beforehand in the sending side and calculating a right token in the STB is described hereunder.

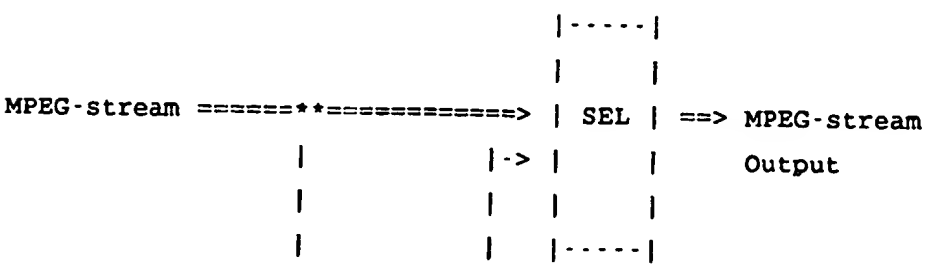


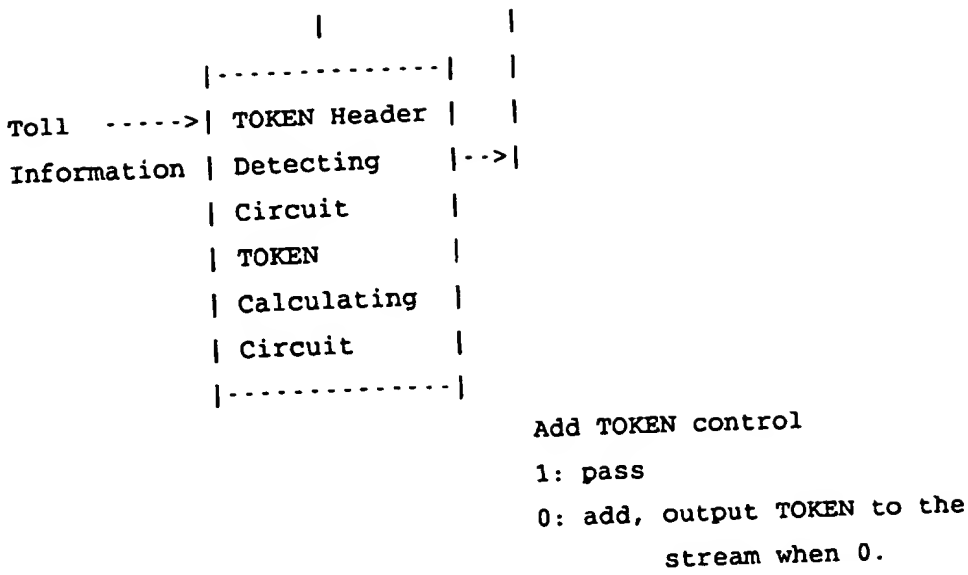
A method of destructing a TOKEN and a method of adding a TOKEN are now specifically described hereunder.

In the method of destructing a TOKEN, the stream of MPEG is monitored to find a TOKEN Header as shown below. If the TOKEN Header is found, a control is effected as to whether to destruct the TOKEN following the TOKEN Header or not by taking the toll information into consideration. A TOKEN Header detecting circuit as well as an AND circuit for destructing a TOKEN can be easily implemented.



In the method of adding a TOKEN, the stream of MPEG is monitored and the TOKEN is calculated from the stream to find the TOKEN Header. If the TOKEN Header is found, the TOKEN is overwritten in the TOKEN area (containing dummy data) following the TOKEN Header by taking the toll information into consideration. A TOKEN Header detecting circuit,a TOKEN calculating circuit and a SELector circuit for adding a TOKEN can be easily implemented.





As shown in the above embodiments, added information (TOKEN) for controlling copying (copy permitted or not) of a digital image output using a watermarking can be easily modified within the STB based on a smart card in a consumer box of an STB, etc., of a digital broadcasting, user toll information and user input information. It is important here that there is no need to obtain Copy Control Information (CCI) within the STB.

By using the method of this invention, an effect which is as good as or better than a conventional system in which an electronic watermarking technique is used for the entire data control is obtained with the number of logic gates which is 1/20 of the conventional system in an application of permitting one time copy of a distributed content because only a function for disabling a token is required beside electronic watermarking chips which are inherently required for detecting the CF.

In addition, when a token is embedded using only the electronic watermarking technique, it can be embedded only in the I frame so that the embedded "copy done" mark is ineffective if it departs from the MPEG format. On the other hand, while the token similarly becomes ineffective when it departs from the MPEG format, the effect of prohibiting copying survives any change of the data format because copying can not be done if the token becomes ineffective, thereby providing a more secure data control.

Further, added information (TOKEN) for controlling copying of a digital image output using a watermarking can be easily modified within the STB based on a smart card in a consumer box of an STB, etc., of a digital broadcasting, user toll information and user input information without the need to obtain Copy Control Information (CCI) within the STB.

CLAIMS

1. A data control system comprising:

means for embedding within data to be distributed, using an electronic watermarking technique, a control flag for effecting data processing operation control;

means for preparing a token, using the content of said data, having information as to how to control the data;

means for appending said token to said data;

means for distributing said data to which said token is appended;

means for detecting said control flag within the distributed data;

means for reading said token appended to said data when said control flag is detected; and

means for controlling said data processing operation according to the information in said token and a predefined control rule of said token or said control flag.

2. A data control system of claim 1 in which said means for controlling further comprises means for modifying, disabling or deleting said token.

3. A data control system of claim 2 in which said data processing operation is a copying, play-back or receiving operation.

4. A data copying apparatus for controlling the copying of data which has a control flag, embedded therein by an electronic watermarking technique, for effecting control of copying of the data and which data has a token appended thereto, the token including copying control information for the data, the apparatus comprising:

means for detecting within data to be copied the embedded control flag;

means, responsive to detection of said control flag, for retrieving from said appended token the copying control information for the data; and

means for effecting copying control of said data according to a predefined control rule corresponding to said copying control information.

5. A data play-back apparatus for controlling the play-back of data which has a control flag, embedded therein by an electronic watermarking technique, for effecting control of play-back of the data and which data has a token appended thereto, the token including play-back control information for the data, the apparatus comprising:

means for detecting within data to be played back the embedded control flag;

means, responsive to detection of said control flag, for retrieving from said appended token the play-back control information for the data; and

means for effecting play-back control of said data according to a predefined control rule corresponding to said play-back control information.

6. A data receiving apparatus for controlling receiving of data which has a control flag embedded therein by an electronic watermarking technique for effecting control of receiving of the data and which data has a token appended thereto, the token including control information for the data, the apparatus comprising:

means for detecting within received data the embedded control flag;

means, responsive to detection of said control flag, for retrieving from said appended token the control information for the data; and

means for effecting control of receiving of said data according to a predefined control rule corresponding to said control information.

7. A data control apparatus comprising;

means for detecting from data a control flag for effecting control of the data, which control flag is embedded in the data using an electronic watermarking technique;

means for reading a token, which is appended to the data, the token indicating how to control the data when said control flag is detected, and

means for effecting control of said data according to a predefined control rule of said token or said control flag.

8. A token preparation apparatus preparing a token for effecting data control comprising;

means for embedding in the data, using an electronic watermarking technique, a control flag to effect control of the data,

means for preparing, using the content of said data, a token having information as to how to control the data, and

means for appending said token to said data.

9. A data control system comprising;

means for embedding in data to be distributed a control flag to effect control of the data, using an electronic watermarking technique,

means for preparing, using the content of said data, a first token having information as to how to control the data,

means for appending said first token to said data,

means for distributing said data to which said first token is appended,

means for detecting said control flag from the distributed data,

means for reading out said first token appended to said data,

means for preparing a second token from said data,

means for comparing the first token with the second token, and

means for effecting control of said data according to a predefined control rule of said first token or said control flag using the result of said comparison.

10. A data control system according to claim 9 in which said means for effecting control of data further comprises means for deleting or disabling said appended token.

11. A data control system according to claim 10 in which said means for preparing a first token and said means for preparing a second token include means for preparing a token from the data using a one-way function.

12. A data control system according to claim 11 in which said control is a control of a copying, play-back or receiving operation.

13. A data copying apparatus according to claim 4, including:

means for preparing a second token from said data,

means for comparing the appended token with the prepared token, and

means for effecting control of said data relating to copying according to a predefined control rule of said appended token or said control flag when said comparison matches.

14. A data play-back apparatus according to claim 5, including:

means for preparing a second token from said data,

means for comparing the appended token with the token prepared, and

means for effecting control of said data relating to play-back according to a predefined control rule of said appended token or said control flag using the result of said comparison.

15. A data receiving apparatus according to claim 6, including:

means for preparing a second token from said data,

means for comparing the appended token with the token prepared, and

means for effecting control of said data relating to receiving according to a predefined control rule of said appended token or said control flag when said comparison matches.

16. A data control apparatus according to claim 7, including:

means for preparing a second token from said data,

means for comparing the appended token with the token prepared, and

means for effecting control of said data according to a predefined control rule of said appended token or said control flag when said comparison matches.

17. A data control system according to any one of claims 13 to 16 in which said means for effecting control of data further comprises means for deleting or disabling said appended token.

18. A token preparation apparatus for preparing a token for effecting data control comprising:

means for embedding in the data, using an electronic watermarking technique, a control flag to effect control of the data;

means for preparing, using the content of said data, a token having information as to how to control the data; and

means for appending said token to said data.

19. A data control system according to any one of claims 13 to 18 in which said means for preparing a token further comprises means for preparing a token from the data using a one-way function.

20. A data control method comprising:

a step of embedding within data to be distributed a control flag for effecting data control, the embedding using an electronic watermarking technique;

a step of preparing, using the content of said data, a token having information as to how to control the data;

a step of appending said token to said data;

a step of distributing said data to which said token is appended;

a step of detecting said control flag from the distributed data;

a step of reading out said token appended to said data when said control flag is detected; and

a step of controlling said data according to a predefined control rule of said token or said control flag.

21. A data control method of claim 20 in which said step of controlling said data further comprises a step of modifying, disabling or deleting said token.

22. A data control method of claim 21 in which said control is a control of copying, play-back or receiving.

23. A computer program product comprising computer program code recorded on a computer-readable recording medium, said program code being for controlling the performance of data processing operations on data having a control flag embedded therein using an electronic watermarking technique and having a token appended thereto, said token indicating how to effect control of the data when said control flag is detected, said program code comprising:

logic for detecting from data the control flag for effecting control of the data;

logic for reading out said token appended to said data; and

logic for effecting control of said data according to a predefined control rule of said token or said control flag.

Patent Office

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Claims searched: 1-26

Examiner: K. Sylvan
Date of search: 1 February 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): G4A (AAP) H4F (FBB) G5R (RHB)

Int Cl (Ed.6): H04N (1/32) G11B (20/00)

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	WO97/13248 A1	Philips. See page 5 lines 4-24.	-
A,P	WO98/33176 A2	Philips. See abstract.	-
X,P	WO98/33325 A2	Philips. See page 6 lines 7-14.	4,7 at least
A	US5659613	Macrovision.	-

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.